Dynamic Cushioning Performance Criteria for Snowmobile Seats – SAE J89 JAN85

SAE Recommended Practice
Completely Revised January 1985

DYNAMIC CUSHIONING
ϕ PERFORMANCE CRITERIA FOR SNOWMOBILE SEATS—SAE J89 JAN85

SAE Recommended Practice

Report of the Snowmobile and All-Terrain Vehicle Committee, approved July 1973, completely revised, Snowmobile Committee, January 1985. Rationale statement available.

1. Introduction

1.1 Purpose—The purpose of this SAE Recommended Practice is to facilitate the development of seats used on snowmobiles to minimize occupant spinal injury during impacts of:

(a) The occupant on the snowmobile seat.

(b) The snowmobile and seat on the occupant.

Operators and passengers of snowmobiles can be subjected to high levels of impact with the snowmobile seat under riding conditions. This recommended practice was developed to identify the cushioning properties of snowmobile seats. Information on the technical development of this recommended practice is contained in SAE J89a.

1.2 Scope—This recommended practice encompasses the significant factors which determine the effectiveness of a seat system in limiting spinal injury during vertical impacts between the rider and the snowmobile seat system. The recommended practice is intended to provide a tool for the development of safer snowmobile seats. It is recognized that the seat is only a portion of the entire vehicle protective suspension system. It is, however, usually required that the seat serve as added protection to the suspension system, since the latter may "bottom out" during a severe impact.

The term "seat" refers to the occupant-supporting system not normally considered part of the vehicle suspension or frame system. In some cases, it may include more than the foam cushion.

This recommended practice provides the minimum requirements for performance of a general seat system, and a description of specific means of evaluating the shock-absorbing characteristics of foam seat cushions using a specific testing procedure and a companion seat evaluation chart.

The test input and means of interpreting the results are unique to the seats of typical recreational snowmobiles. Therefore, this recommended practice is to be used for snowmobile seats only and is not to be used to evaluate seats of any other type of vehicle. In addition, it should not be applied to seats of snow vehicles of significantly different design, dimensions, construction, or intended usage from the typical recreational snowmobile illustrated in SAE J33.

1.3 Contents

2. Dynamic Cushioning Testing Method

2.1 Scope—This procedure provides a uniform method for measuring, with a high degree of reproducibility, dynamic cushioning properties such as the deceleration-time history profile of a standard buttocks form ("missile") impacting seat test specimens. The results from this testing method can be related to the performance requirements necessary to limit spinal injury to snowmobile riders and passengers.

2.2 Definitions

2.2.1 SNOWMOBILE SEAT—The seat includes the cover, energy-absorbing materials, and substrates (if any).

2.2.2 BASELINE—The baseline is the starting reference plane of the seat from which total penetration is determined. It is taken as the top plane of the seat at the fore-aft position designated for the snowmobile occupant(s).

2.2.3 G—Symbol for the dimensionless ratio of any acceleration to the acceleration of gravity.

2.2.4 t_p—Time duration from impact to peak deceleration, in milliseconds.

2.2.5 t_h—Time duration from impact to ½ value of peak deceleration, in milliseconds.

2.3 Apparatus

2.3.1 TESTING MACHINE—Any design of dynamic testing apparatus will suffice when the following criteria are met. (See Fig. 2.)

2.3.1.1 The weighted missile can be held in readiness for impact, released upon command, and guided to the point of impact.

2.3.1.2 The test specimen should be supported on a foundation which under impact will not deflect more than 1% of the thickness of the specimen.

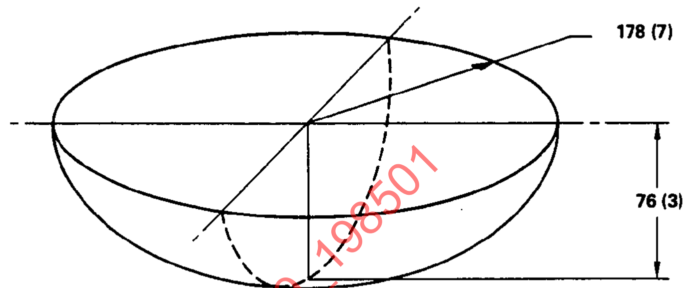


FIG. 1—SEAT IMPACT FORM

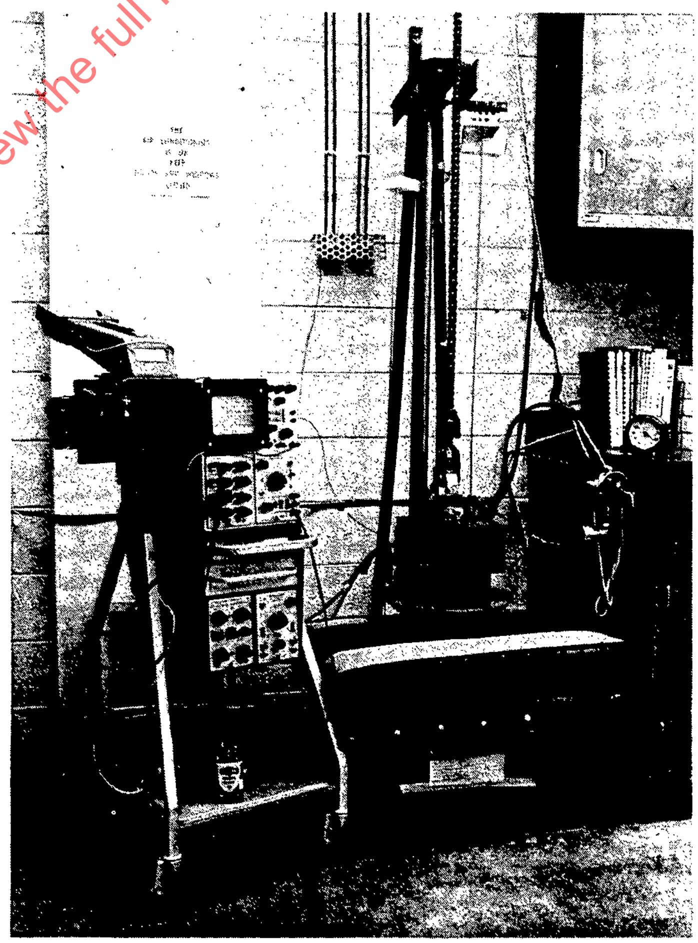


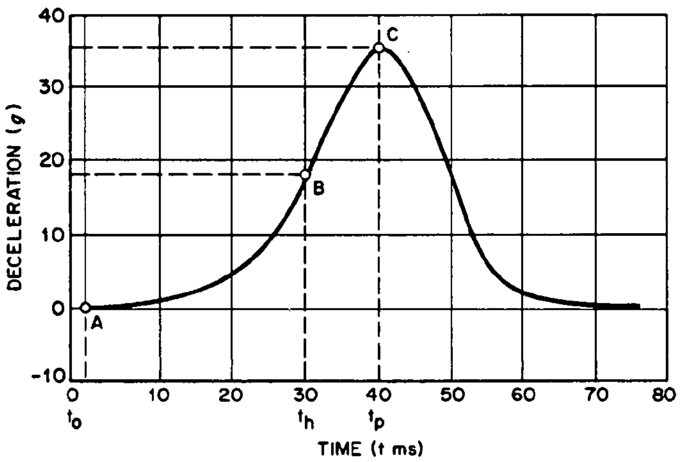
FIG. 2—DYNAMIC TESTING APPARATUS

The ϕ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

2.3.1.3 The deceleration-time profile, as illustrated in Fig. 3, can be read out and recorded on an instrument, such as an oscilloscope, starting at the time of initial contact of the missile on the seat.

2.3.2 Sensing Devices

2.3.2.1 The missile shall be equipped with an accelerometer system which shall be capable of measuring single impacts of short duration



TRACE ABC = G-TIME TRACE WHERE:

A = START OF IMPACT

B = ½ PEAK g (½ C)

C = PEAK DECELERATION (g MAX)

FIG. 3—TYPICAL G-TIME TRACE

(less than 0.105 s) in the 5—100 g range with an accuracy of ±2% throughout the duration of the pulse.

2.3.2.2 A penetration measuring device or some other means is required to determine the exact starting time of the penetration. A velocity measuring device shall be used for measuring the impacting velocity of the missile if the missile is not totally free to fall under the influence of gravity.

2.3.3 Missile—The missile shall be a rigid segment of a hemisphere, the sphere having a radius of 245 mm (9.65 in) and the segment having a radius of 178 mm (7 in). (See Fig. 1.) The top surface of the missile must be designed to accommodate weights to provide total missile mass capability of 90.7 kg (200 lb).

2.3.4 Recording Equipment—The acceleration-time recording equipment should be capable of recording impacts compatible with the accuracy of the accelerometer. Some type of triggering device will be necessary for the recording device.

2.3.5 Test Specimen—Any seating system, or component, for which dynamic cushioning data is desired. The number of specimens tested as a sample can vary widely depending upon the intended use of the data. It is recommended that at least three specimens be tested for each set of conditions. The specimens shall be conditioned at 21 ± 6°C (70 ± 10°F) for a minimum of 8 h prior to testing.

2.4 Procedure

2.4.1 Prewarm the recording equipment as recommended by the manufacturer.

2.4.2 Place the test specimen in position under the missile such that the designated seating position coincides with the center of the missile. Mass of the missile shall total 90.7 kg (200 lb).

2.4.3 Determine the baseline by contacting the specimen with the missile and adjust the recording apparatus to read zero penetration.

2.4.4 Set the missile propelling mechanism at a position to obtain the desired impact velocity of 3.15 m/s (124 in/s) [equivalent to 500 mm (20 in) free fall] at the impact surface of the specimen.

2.4.5 Calibrate the G-time recorder according to the recommended procedure of the manufacturer.

2.4.6 Release the missile and record the acceleration-time profile using the recommended procedures of the equipment manufacturer. Five consecutive strikes shall be made at 2 min intervals on the same impact area.

2.4.7 Each passenger's designated seating position (if the snowmobile is designed for passengers) and each designated seating position of the operator shall be tested.

3. Evaluation—The following procedure shall be applied to each designated seating position.

3.1 Data—Using the deceleration time trace from the fifth impact on each of the three specimens, record the peak deceleration (point C), the time from impact to peak deceleration (point t_p), and the time from impact to ½ peak deceleration (point t_h) for the designated seating position. Calculate and record the average value for C, t_p, and t_h and, using these average values, calculate and record the percent distortion using the following formula.

$$\% \text{ distortion} = \frac{2t_h - t_p}{t_p} \times 100\%$$

3.2 Chart Usage—On the seat evaluation chart (Fig. 4), plot the above calculated average values of peak deceleration (C) and time from impact to peak deceleration (t_p). If this point lies above the 90% distortion line, the seat fails. If the point lies below the 30% distortion line, the seat passes. If the data point lies within the region of 30—90% distortion, then the point must be evaluated with respect to its calculated percent distortion. If the data point lies above its distortion value, the seat fails. If the data point lies below its distortion value, the seat passes.

As an example of the above procedure:

$$t_p = 40 \text{ ms}$$
$$t_h = 30 \text{ ms}$$
$$G_{max} = 35 \text{ g}$$

Then

$$\% \text{ distortion} = \frac{2(30) - 40}{40} \times 100\% = 50\%$$

Plotting 35 g at 40 ms on Fig. 4 indicates the data point falls above its distortion curve. Therefore, the seat fails. If G_{max} had been below 35 g, the seat would have passed.

Note: The particular procedure described above is not applicable to seats giving rise to deceleration pulses of shapes radically different from that shown in Fig. 3. The specific method of seat evaluation described in this section is generally applicable to foam seat cushions.